IN THE DRAWINGS

The drawings have been amended from the originally filed PCT application, by designating "Prior Art" on FIG. 1. A complete set of corrected drawing FIGS. 1-10 are submitted herewith.

REMARKS

Applicant has, by this Preliminary Amendment, amended the specification to correct typographical errors and to comply the same with U.S. practice. As per 37 C.F.R. §1.125, Applicant has submitted herewith a substitute specification incorporating these changes in the application as filed. A marked-up version of the substitute specification is also enclosed herewith. No new matter has been added.

Applicant has amended the claims to conform same to U.S. practice and correct typos.

Applicant respectfully requests examination based on the amended claims as presented herein. Claims 1-33 are now pending in this application. Claims 12-33 have been added. No new matter has been introduced. Early and favorable consideration is respectfully requested.

Respectfully submitted,
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By :_____
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A PARALLELEPIPED TYPE CONDENSER MICROPHONE FOR SMD

TECHNICAL FIELD

The present invention relates to a condenser microphone, and more particularly to a condenser microphone having a shape of a parallelepiped for easily confirming the direction of a component in the process of SMD even if the microphone has two or more electric connecting terminals.

BACKGROUND ~~ART~~

A typical condenser microphone includes a voltage bias element, which is generally comprised of electrets, a pair of diaphragm/back plate forming capacity C that can be varied in response to sound pressure, and a JFET (Junction Field Effect Transistor) for buffering output signal.

Fig. 1 is a schematic view of a conventional general condenser microphone.

As shown in Fig. 1, a typical condenser microphone 10 has a cylindrical metal case including a polar ring, a diaphragm, a spacer, a back plate, a first base which has a shape of a ring made of insulating material, a second base which is made of conductive material, and a PCB, etc., therein. The typical condenser microphone has an appearance having a cylindrical shape and two connection terminals are formed in the PCB.

Meanwhile, during a surface mounting process, terminals of the main PCB must be correctly connected with terminals of the condenser microphone. However, the above-mentioned conventional cylindrical condenser microphone had a construction, which was not suitable for surface mounting device (SMD). Because a terminal surface is formed lower than a curling surface of the case, a failure of solder attachment may be caused during the surface mounting process. In particular, if there are provided a plurality of terminals therein, it will be difficult to confirm the direction of connection terminals. Thus, ~~this has arisen~~ a problem has arisen that the connection terminals are inadequately connected under the condition that polarity of the connection terminals has been changed during the surface mounting process or that only a part of surfaces of the connection terminals is connected because the surface of the connection terminal is deviated, and thus, a failure of connection is increased.

~~DISCLOSURE OF THE INVENTION~~SUMMARY

The present invention is intended to solve the problem as mentioned above. It is an object of the present invention to provide a parallelepiped type condenser microphone wherein the direction of a component can be easily confirmed and the SMD process can be applied even if the microphone has numerous connecting terminals.

In order to accomplish the object of the invention, a condenser microphone according to an embodiment of the present invention, comprises a case formed in a square box shape, the case having an open surface and a closed bottom surface which is formed with sound holes for collecting sound; a diaphragm member formed in a ring shape, the diaphragm member being inserted into the case; a thin spacer formed in a ring shape; a cylindrical insulating ring having an open top and bottom portions; a back plate formed in a disk shape and having sound holes therethrough; an annular conductive ring for electrically connecting the back plate to a PCB; and the PCB formed in a square plate shape, the PCB having electronic components mounted on one surface of the PCB and projecting terminals formed on the other surface thereof. Here, the diaphragm member, the spacer, the insulating ring, the back plate, the conductive ring, and the PCB are sequentially arranged in the case and then the condenser microphone is integrally assembled by curling an end of the case.

In order to accomplish the object of the invention, a condenser microphone according to another embodiment of the present invention, comprises a case formed in a square box shape, the case having an open surface and a closed bottom surface which is formed with sound holes for collecting front sound; a diaphragm member formed in a ring shape, the diaphragm member being inserted into the case; a thin spacer formed in a ring shape; a shield ring formed in a loop shape for insulating a back plate; the back plate formed in a disk shape and having sound holes- therethrough; an integrated base having a cylindrical insulating body having open top and bottom portions and a conductive layer which provides an electrical connection between the back plate and a PCB and is formed in the inner surface of the insulating body; and the PCB formed in a square plate shape, the PCB having electronic components mounted on one surface of the PCB and projecting terminals formed on the other surface thereof. Here, the diaphragm member, the spacer, the shield ring, the back plate, the integrated base, and the PCB are sequentially arranged in the case and then the condenser microphone is integrally assembled by curling an end of the case.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects and features of the invention will become apparent from the following description of preferred embodiments taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a schematic view of a conventional general condenser microphone;

Fig. 2 is a perspective view of a parallelepiped type condenser microphone according to the present invention;

Fig. 3 is an exploded perspective view of a first embodiment of a condenser microphone according to the present invention;

Fig. 4 is an exploded perspective view of a second embodiment of a condenser microphone

according to the present invention;

Fig. 5 is an exploded perspective view of a third embodiment of a condenser microphone according to the present invention;

Fig. 6 is a side cross-sectional view of assemblies of the first, second and third embodiments of the present invention;

Fig. 7 is an exploded perspective view of a fourth embodiment of a condenser microphone according to the present invention;

Fig. 8 is an exploded perspective view of a fifth embodiment of a condenser microphone according to the present invention;

Fig. 9 is an exploded perspective view of a sixth embodiment of a condenser microphone according to the present invention; and

Fig. 10 is a side cross-sectional view of assemblies of the fourth, fifth and sixth embodiments of the present invention.

~~BEST MODES FOR CARRYING OUT THE INVENTION~~DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The preferred embodiments of the present invention will be now described in detail below with reference to the accompanying drawings.

Fig. 2 is a perspective view of a parallelepiped type condenser microphone according to the present invention.

As shown in Fig. 2, the condenser microphones 100~600 according to the present invention includes a parallelepiped case into which components are inserted and is adapted to be connected to a main PCB through a projecting terminal formed on a surface of PCB thereof. This condenser microphones 100~600 of the present invention is formed in a parallelepiped shape. Therefore, the direction of components can be easily adjusted upon surface mounting, and this can solve a problem that the connecting surface of connection terminals of the main PCB and the condenser microphone may be deviated or the direction thereof may be shifted. The parallelepiped type condenser microphones of the present invention can be constructed by a variety of components. The first to sixth embodiments will be now described in detail.

[First embodiment]

Fig. 3 is an exploded perspective view of the first embodiment of a parallelepiped type condenser microphone according to the present invention.

Referring to Fig. 3, the condenser microphone 100 according to the present invention comprises a case 102 having an open surface and a closed bottom surface which is formed with sound

holes 102a for collecting sound and formed in a square box shape; a diaphragm member 104 having a shape of a ring, which is inserted into the case formed in a square box shape; a thin spacer 106 formed in a ring shape; a cylindrical insulating ring 108 having an open top and bottom portions; a back plate 110 formed in a disk shape and having sound holes 110a therethrough; an annular conductive ring 112 for electrically connecting the back plate 110 to a printed circuit board (PCB; 114); and the PCB 114 formed in a square plate shape, having components (e.g., IC, MLCC) mounted on one surface of the PCB and projecting terminals 116 formed on the other surface thereof. Here, the diaphragm member 104 includes a polar ring 104a for connecting electrically to the case 102 and a diaphragm 104b vibrated by sound pressure. The back plate 110 comprises a metal plate to which an organic film formed with electrets is fused. Further, it is desired that the case 102 is not provided with sound holes at the central portion of the bottom surface thereof, since the center of bottom surface of the case is a position for picking up the microphone from a tape &and reel package in the process of SMD.

[Second embodiment]

Fig. 4 is an exploded perspective view of the second embodiment of a parallelepiped type condenser microphone according to the present invention.

Referring to Fig. 4, the condenser microphone 200 according to the present invention comprises a case 202 having an open surface and a closed bottom surface which is formed with sound holes 202a for collecting sound and formed in a square box shape; a diaphragm member 204 having a square peripheral surface which is inserted into the case 202 formed in a square box shape and a circular diaphragm formed on the inside thereof; a spacer 206 having a square peripheral surface and a circular inner circumferential surface; a square box shaped insulating ring 208 having an open top and bottom portions; a back plate 210 formed in a square shape and having sound holes 210a therethrough; an conductive ring 212 having a square peripheral surface for electrically connecting the back plate 210 to a PCB 214 and a circular inner circumferential surface; and the PCB 214 formed in a square plate shape, having components (e.g., IC, MLCC) mounted on one surface of the PCB and projecting terminals 216 formed on the other surface thereof. Here, the diaphragm member 204 includes a polar ring 204a for connecting electrically to the case 202 and a diaphragm 204b vibrated by sound pressure. The back plate 210 comprises a metal plate to which an organic film formed with electrets is fused. Further, it is desired that the case 202 is not provided with sound holes at the central portion of the bottom surface thereof, since the center of bottom surface of the case is a position for picking up the microphone from a tape &and reel package in the process of SMD.

[Third embodiment]

Fig. 5 is an exploded perspective view of the third embodiment of a parallelepiped type

condenser microphone according to the present invention.

Referring to Fig. 5, the condenser microphone 300 according to the present invention comprises a case 302 having an open surface and a closed bottom surface which is formed with sound holes 302a for collecting sound and formed in a square box shape; a diaphragm member 304 having a square peripheral surface which is inserted into the case formed in a square box shape and a square diaphragm on the inside thereof; a spacer 306 having a square peripheral surface and a square inner circumferential surface; a square box shaped insulating ring 308 having an open top and bottom portions; a back plate 310 formed in a square shape and having sound holes 310a therethrough; an conductive ring 312 having a square peripheral surface for electrically connecting the back plate 310 to a PCB 314 and a square inner circumferential surface; and the PCB 314 formed in a square plate shape, having components (e.g., IC, MLCC) mounted on one surface of the PCB and projecting terminals 316 formed on the other surface thereof. Here, the diaphragm member 304 includes a polar ring 304a for connecting electrically to the case 302 and a diaphragm 304b vibrated by sound pressure. The back plate 310 comprises a metal plate to which an organic film formed with electrets is fused. Further, it is desired that the case 302 is not provided with sound holes at the central portion of the bottom surface thereof, since the center of bottom surface of the case is a position for picking up the microphone from a tape and~~&~~ reel package in the process of SMD.

[Operations of the first to third embodiments]

Fig. 6 is a side cross-sectional view of assemblies of the first, second and third embodiments of the present invention. Reference numerals of the components are denoted using those of the first embodiment representatively.

Referring to Fig. 6, the condenser microphones 100~300 of the first to the third embodiments have a square box shaped case 102, respectively, in which a diaphragm member 104a, 104b, a spacer 106, an insulating ring 108, a back plate 110, a conductive ring 112, and a PCB 114 formed in a square plate shape are sequentially arranged. Thereafter, the condenser microphones are assembled and constructed such that ends of the case 102 are curled. Here, each of the components can be assembled by exchanging the components depending on convenience of manufacture and assembly of the components.

Projecting terminals 116 are formed on an exposed surface of the PCB 114 and the projecting terminals are projected than the curling surface such that the condenser microphones 100~300 can be attached to a main PCB, for example, a PCB of a cellular phone, in SMD method. These terminals 116 may be terminals for a Vdd connection and a ground terminal, and terminals ~~required according~~for additional functions.

Further, square components of the first to the third embodiments may have edges formed in

~~a round shape which area~~ round shape which is in contact each other, depending on convenience of manufacture and assembly of the components. An IC mounted in the PCB includes a junction field effect transistor (JFET), an amplifier, an analog-digital (A/D) converter or an ASIC, which is an IC customizing the amplifier and the analog-digital (A/D) converter.

Operations of the condenser microphones of the first to third embodiments will be carried out as follows.

The projecting terminals 116 of the condenser microphone 300 according to the present invention are connected to connection terminals of the main PCB. Vdd and GND powers are applied to the projecting terminals. Accordingly, in the condenser microphones 100~300 according to the present invention, the diaphragm 104b is electrically connected to the PCB 114 through the case 102 and the polar ring 104a, and the back plate 110 is electrically connected to the PCB 114 through the conductive ring 112.

In this condition, a sound from an external sound source ~~is~~ flowed~~s~~ in an inside of the microphone through the sound hole 102a of the case and is transmitted to the diaphragm 104b. The sound collected to a back chamber is transferred through the sound holes 110a of the back plate 110 to the diaphragm 104b.

Thus, the diaphragm 104b is vibrated by the sound pressure. Then, a gap between the diaphragm 104b and the back plate 110 can be varied. The electrostatic capacity produced by the diaphragm 104b and the back plate 110 is varied and thus, a change of an electric signal (voltage) according to a sound wave can be attained. This signal is transmitted to the IC mounted in the PCB 114 along the above electrical connection path to be amplified and then outputted to an external circuit through the projecting terminals 116.

[Fourth embodiment]

Fig. 7 is an exploded perspective view of a fourth embodiment of a condenser microphone according to the present invention.

Referring to Fig. 7, the condenser microphone 400 of the present invention comprises a case 402 having an open surface and a closed bottom surface which is formed with sound holes 402a for collecting front sound and formed in a square box shape; a diaphragm member 404 having a shape of a ring, which is inserted into the case formed in a square box shape; a thin spacer 406 formed in a ring shape; a shield ring 408 formed in a loop shape for insulating a back plate 410; the back plate 410 formed in a disk shape and having sound holes 410a therethrough; an integrated base 412 having a conductive layer 412b which provides an electrical connection between the back plate 410 and the PCB 414 and is formed in an inner surface of a cylindrical insulating body 412a having open top and bottom portions; and a PCB 414 formed in a square plate shape, having components (e.g., IC,

MLCC) mounted on one surface of the PCB and projecting terminals 416 formed on the other surface thereof.

Here, the diaphragm member 404 includes a polar ring 404a for connecting electrically to the case 402 and a diaphragm 404b vibrated by sound pressure. The back plate 410 comprises a metal plate to which an organic film formed with electrets is fused. Further, it is desired that the case 402 is not provided with sound holes at the central portion of the bottom surface thereof, since the center of bottom surface of the case is a position for picking up the microphone from a tape &and reel package in the process of SMD.

The integrated base 412 has a construction such that the hollow cylindrical insulating body 412a is used as a PCB using a PCB technique and then the conductive layer 412b of a metal plate having an outer diameter smaller than a peripheral outer diameter thereof is formed in both sides and an inner circumferential surface of the hollow cylindrical insulating body 412a.

Like this, the integrated base 412 according to the present invention is constructed such that a first base performing a conventional insulating function and a second base performing a conducting function can be ~~comprised of~~ one integral base. The outer diameter of the metal plate should be smaller than an outer diameter of the insulating body so as not to be contacted to the case. Here, the insulating body may preferably be comprised of glass epoxy base, resin base, or PVC based insulating printed board.

Although it is not shown specifically, the insulating body 412a performs an insulating function and also can provide a conductive function by forming a metal plated layer in one side thereof to be contacted to the diaphragm member 410 and the other side thereof to be contacted to the PCB 414 and then connecting the top and bottom metal plated layers with a through hole or via hole such that the metal plated layer can be electrically connected.

[Fifth embodiment]

Fig. 8 is an exploded perspective view of a fifth embodiment of a condenser microphone according to the present invention.

Referring to Fig. 8, the condenser microphone 500 of the present invention comprises a case 502 having an open surface and a closed bottom surface which is formed with sound holes 502a for collecting sound and formed in a square box shape; a diaphragm member 504 having a square peripheral surface which is inserted into the case formed in a square box shape and a square inner circumferential diaphragm; a spacer 506 having a square peripheral surface and a square inner circumferential surface; a shield ring 508 formed in a square ring shape for insulating a back plate 510; the back plate 510 formed in a square shape and having sound holes 510a therethrough; an integrated base 512 having a conductive layer 512b which provides an electrical connection between

the back plate 510 and a PCB 514 and is formed in an inner surface of a square box shaped insulating body 512a having open top and bottom portions; and the PCB 514 formed in a square plate shape, having components (e.g., IC, MLCC) mounted on one surface of the PCB and projecting terminals 516 formed on the other surface thereof.

Here, the diaphragm member 504 includes a polar ring 504a for connecting electrically to the case 502 and a diaphragm 504b vibrated by sound pressure. The back plate 510 comprises a metal plate to which an organic film formed with electrets is fused. Further, it is desired that the case 502 is not provided with sound holes at the central portion of the bottom surface thereof, since the center of bottom surface of the case is a position for picking up the microphone from a tape and~~&~~ reel package in the process of SMD.

The integrated base 512 has a construction such that the hollow cylindrical insulating body 512a is used as a PCB using a PCB technique and then the conductive layer 512b of a metal plate having an outer diameter smaller than a peripheral outer diameter thereof is formed in both sides and an inner circumferential surface of the hollow cylindrical insulating body 512a.

Like this, the integrated base 512 according to the present invention is constructed such that a first base performing a conventional insulating function and a second base performing a conducting function can be ~~comprised of~~ one integral base. The outer diameter of the metal plate should be smaller than an outer diameter of the insulating body so as not to be contacted to the case. Here, the insulating body may preferably be comprised of glass epoxy base, resin base, or PVC based insulating printed board.

Although it is not shown specifically, the insulating body 512a performs an insulating function and also can provide a conductive function by forming a metal plated layer in one side thereof to be contacted to the diaphragm member 510 and the other side thereof to be contacted to the PCB 514 and then connecting the top and bottom metal plated layers with a through hole or via hole such that the metal plated layer can be electrically connected.

[Sixth embodiment]

Fig. 9 is an exploded perspective view of a sixth embodiment of a condenser microphone according to the present invention.

Referring to Fig. 9, the condenser microphone 600 of the present invention comprises a case 602 having an open surface and a closed bottom surface which is formed with sound holes 602a for collecting sound and formed in a square box shape; a diaphragm member 604 having a square peripheral surface which is inserted into the case formed in a square box shape and a circular inner circumferential diaphragm; a spacer 606 having a square peripheral surface and a circular inner circumferential surface; a shield ring 608 having a square peripheral surface for insulating a back plate

610 and a circular inner circumferential surface; the back plate 610 formed in a disk shape and having sound holes 610a therethrough; an integrated base 612 having an insulating body 612a having open top and bottom portions, a square peripheral surface, and a cylindrical inner circumferential surface, and a conductive layer 612b which provides an electrical connection between the back plate 610 and a PCB 614 and is formed in the inner surface of the insulating body 612a; and the PCB 614 formed in a square plate shape, having components (e.g., IC, MLCC) mounted on one surface of the PCB and projecting terminals 616 formed on the other surface thereof.

Here, the diaphragm member 604 includes a polar ring 604a for connecting electrically to the case 602 and a diaphragm 604b vibrated by sound pressure. The back plate 610 comprises a metal plate to which an organic film formed with electrets is fused. Further, it is desired that the case 602 is not provided with sound holes at the central portion of the bottom surface thereof, since the center of bottom surface of the case is a position for picking up the microphone from a tape &and reel package in the process of SMD.

The integrated base 612 has a construction such that the hollow cylindrical insulating body 612a is used as a PCB using a PCB technique and then the conductive layer 612b of a metal plate having an outer diameter smaller than a peripheral outer diameter thereof is formed in both sides and an inner circumferential surface of the hollow cylindrical insulating body 612a.

Like this, the integrated base 612 according to the present invention is constructed such that a first base performing a conventional insulating function and a second base performing a conducting function can be ~~comprised of~~ one integral base. The outer diameter of the metal plate should be smaller than an outer diameter of the insulating body so as not to be contacted to the case. Here, the insulating body may preferably be comprised of glass epoxy base, resin base, or PVC based insulating printed board.

Although it is not shown specifically, the insulating body 612a performs an insulating function and also can provide a conductive function by forming a metal plated layer in one side thereof to be contacted to the diaphragm member 610 and the other side thereof to be contacted to the PCB 614 and then connecting the top and bottom metal plated layers with a through hole or via hole such that the metal plated layer can be electrically connected.

[Operations of the fourth to sixth embodiments]

Operations of the condenser microphones of the fourth to sixth embodiments will be carried out as follows.

Fig. 10 is a side cross-sectional view of assemblies of the fourth to sixth embodiments of the present invention. Reference numerals of components are denoted using those of the fourth embodiment representatively.

Referring to Fig. 10, the condenser microphones 400~600 of the fourth to the sixth embodiments have a square box shaped case 402, respectively, in which a diaphragm member 404, a spacer 406, a shield ring 408, a back plate 410, an integrated base 412, and a PCB 114 formed in a square plate shape are sequentially arranged. Thereafter, the condenser microphones are assembled and constructed such that ends of the case 402 are curled. Here, each of the components can be assembled by exchanging the components depending on convenience of manufacture and assembly of the components.

Projecting terminals are formed on an exposed surface of the PCB 414 and the projecting terminals are projected ~~than~~ beyond the curling surface such that the condenser microphones 400~600 can be attached to a main PCB, for example, a PCB of a cellular phone, in SMD method. These terminals 416 may be terminals for a Vdd connection and a ground terminal, and terminals ~~required according~~ for additional functions.

Further, square components of the fourth to the sixth embodiments may have edges formed in ~~a round shape which area~~ a round shape which is in contact each other, depending on convenience of manufacture and assembly of the components. An IC mounted in the PCB includes a junction field effect transistor (JFET), an amplifier, an analog-digital (A/D) converter or an ASIC, which is an IC customizing the amplifier and the analog-digital (A/D) converter.

Operations of the condenser microphones of the fourth to sixth embodiments will be carried out as follows.

The projecting terminals 416 of the condenser microphone according to the present invention are connected to connection terminals of the main PCB. Vdd and GND powers are applied to the projecting terminals. Accordingly, in the condenser microphones 400~600 according to the present invention, the diaphragm 404b is electrically connected to the PCB 414 through the case 402 and the polar ring 404a, and the back plate 410 is electrically connected to the PCB 414 through the conductive layer 412b of the integrated base 412.

In this condition, a sound from an external sound source is flowed in an inside of the microphone through the sound hole 402a of the case and is transmitted to the diaphragm 404b. The sound collected to a back chamber is transferred through the sound holes 410a of the back plate 410 to the diaphragm 404b.

Thus, the diaphragm 404b is vibrated by the sound pressure. Then, a gap between the diaphragm 404b and the back plate 410 can be varied. The electrostatic capacity produced by the diaphragm 404b and the back plate 410 is varied and thus, a change of an electric signal (voltage) according to a sound wave can be attained. This signal is transmitted to the IC mounted in the PCB 414 along the above electrical connection path to be amplified and then outputted to an external circuit through the projecting terminals 416.

~~INDUSTRIAL APPLICABILITY~~

As described above, according to the condenser microphones of the present invention, because the direction of a component can be confirmed during a process of a surface mounting device (SMD), two or more terminal connections of the component can be easily adjusted with respect to each other. Accordingly, this can prevent connection surfaces of connection terminals of a main PCB and connection terminals of the condenser microphone from being deviated, and also decrease a failure of connection that may be resulted from change of connection or direction (polarity) of the connection terminals.

While the present invention has been described above with reference to the preferred embodiments thereof, it can be understood by the person skilled in the art that various modifications or changes may be made without deviating from the scope and the concept of the present invention described in the accompanying claims.

FIG. 1 (PRIOR ART)

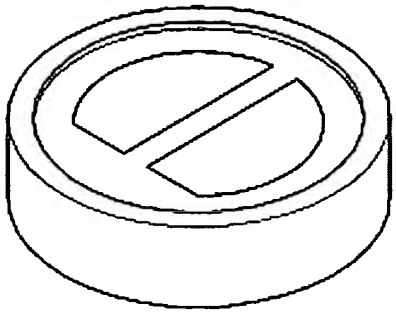

FIG. 2

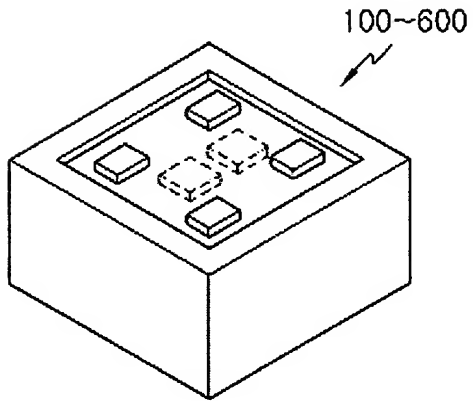

FIG. 3

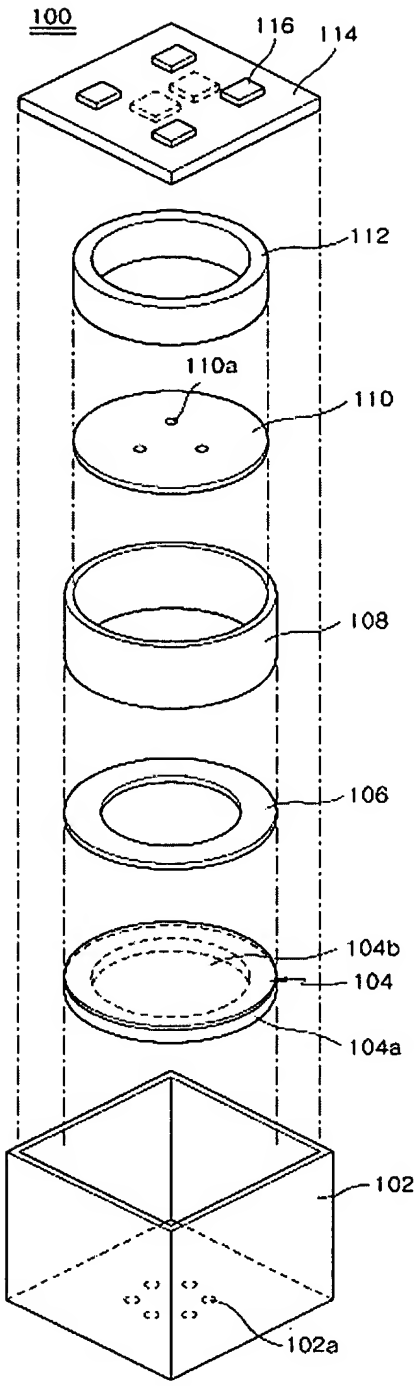

FIG. 4

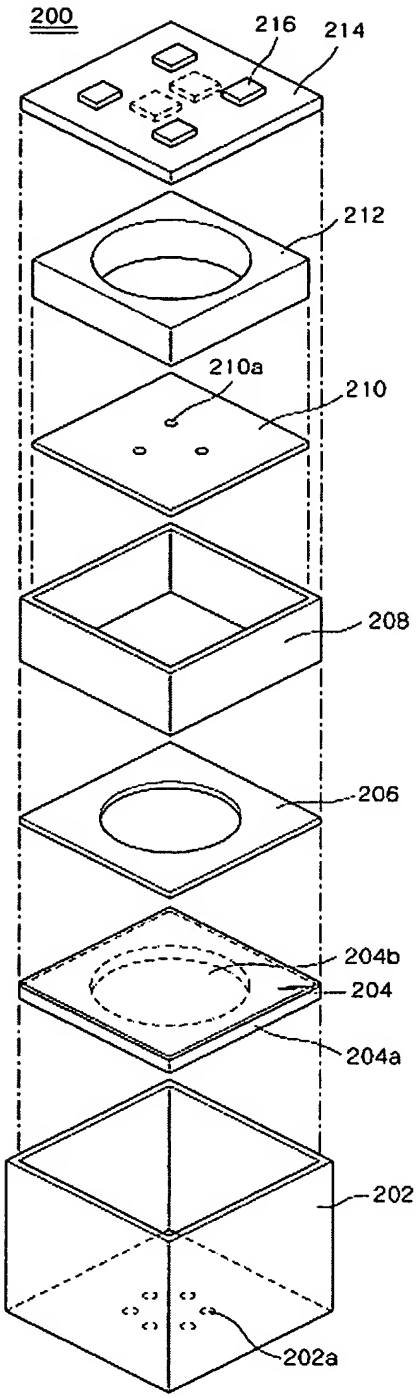

FIG. 5

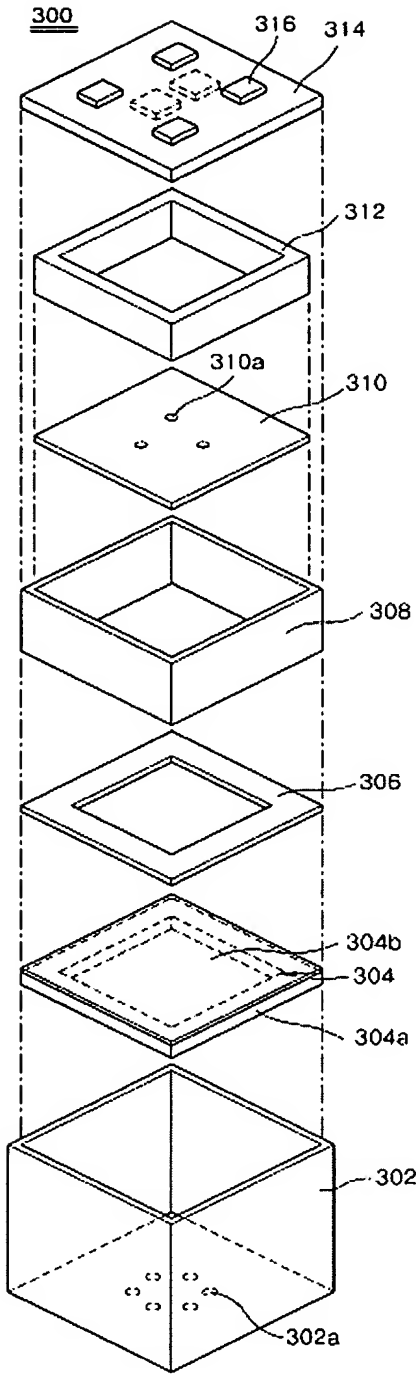

FIG. 6

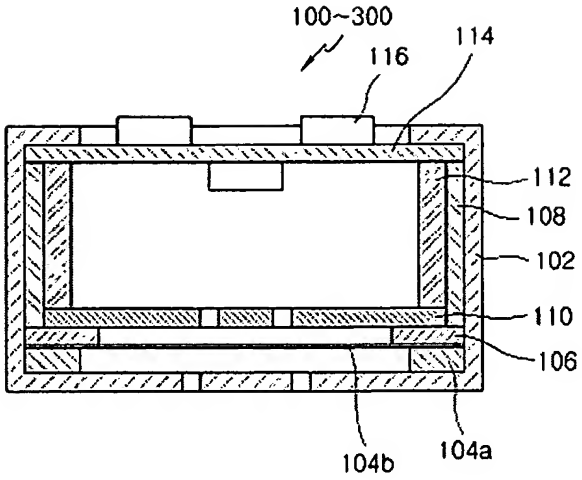

FIG. 7

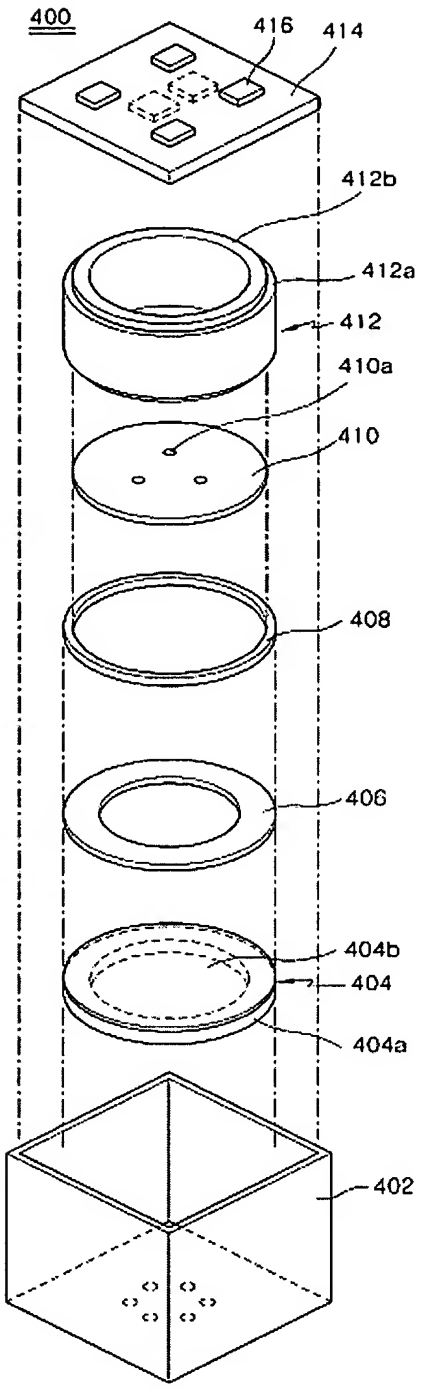

FIG. 8

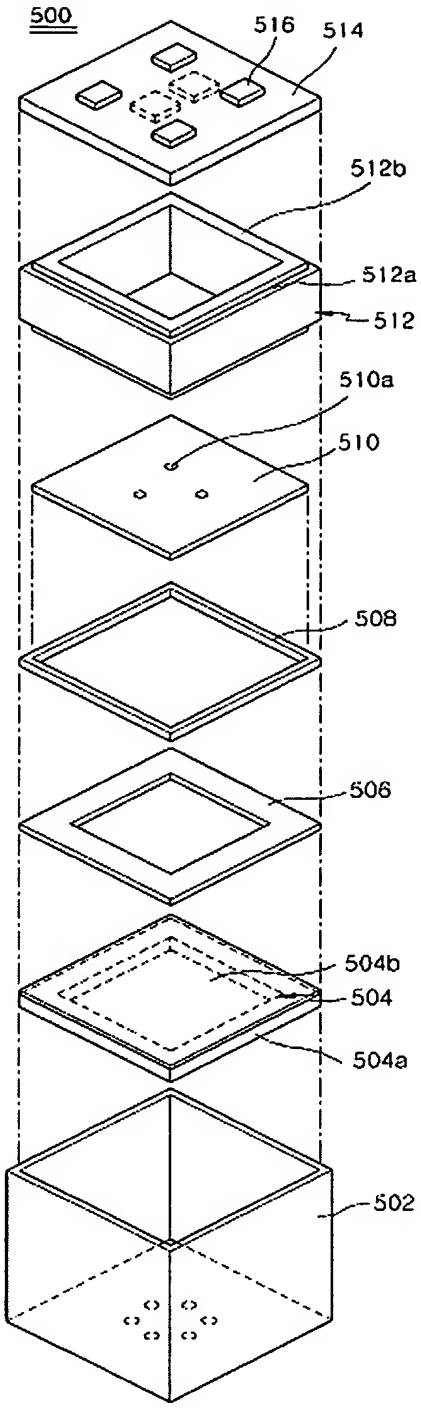

FIG. 9

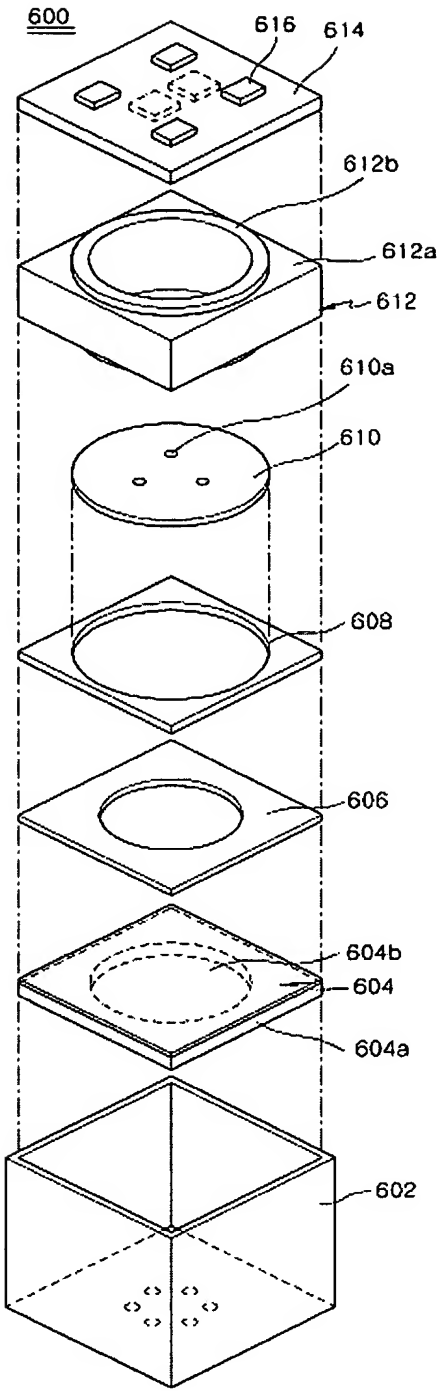

FIG. 10